Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application.

Claim 1 (currently amended): A computer system for coding and decoding digital signals, comprising:

a computer readable medium ~~having~~ storing a dictionary comprising:

codevectors of variable dimension; and ~~stored thereon, said dictionary being intended to be used in a device for at least one of compression coding and decoding of digital signals, by vector quantization at variable rate defining a variable resolution,~~

~~wherein the dictionary comprises:~~

[[-]] inter-embedded sub-dictionaries of increasing resolution of a given dimension, [[- and,]] wherein each sub-dictionary comprises a union [[: •]] of a) a first set consisting of codevectors constructed by inserting, into codevectors of dictionaries of lower dimension, elements taken from a finite set of real numbers according to a finite collection of predetermined insertion rules, [[•]] and of b) a second set consisting of codevectors that may not be obtained by insertion into codevectors of lower dimension of the elements of said finite set according to said collection of insertion rules;

the computer system further comprising:

a processor for coding and decoding digital signals, by vector quantization at variable rate defining a variable resolution, using the stored dictionary.

Claim 2 (previously presented): The computer readable medium as claimed in claim 1, wherein said collection of insertion rules is formulated on the basis of elementary rules consisting in inserting a single element of the finite set of real numbers in the guise of component at a given position of a vector.

Claim 3 (previously presented): The computer readable medium as claimed in claim 2, wherein each elementary rule is defined by a pair of two positive integers representative:

- of a rank of the element in said finite set,
- and of a position of insertion.

Claim 4 (currently amended): A method for operating a coding-decoding device having a processor, comprising:

forming a dictionary comprising codevectors of variable dimension ~~and intended to be used in a device for compression coding and/or decoding of digital signals, by vector quantization at variable rate defining a variable resolution,~~ in which, for a given dimension, the method comprises:

a) forming a first set consisting of codevectors ~~formed~~ by performing an editing operation selected from the group consisting of ~~comprising at least one~~ of inserting into and deleting from codevectors of dictionaries of dimension elements comprising at least one of lower and higher dimension elements taken from a finite set of real numbers according to a finite collection of predetermined editing operation rules selected from the group consisting of insertion rules and deletion rules,

b) constructing a first, intermediate, dictionary comprising at least said first set ~~is constructed~~, for said given dimension, and

c) ~~and, to adapt~~ adapting said dictionary to a use with at least one given resolution, a second, definitive, dictionary is constructed, on the basis of the intermediate dictionary, by performing at least one of embedding and simplification of dictionaries of at least one of increasing and decreasing resolutions, the dictionaries of increasing resolutions being inter-embedded from the dictionary of smallest resolution up to the dictionary of greatest resolution;

performing at least one of compression coding and decoding of digital signals using the processor, by vector quantization at variable rate defining a variable resolution, using the formed dictionary.

Claim 5 (currently amended): The method as claimed in claim 4, in which, for a given dimension **N**:

a0) an initial dictionary of initial dimension **n**, lower than said given dimension **N**, is obtained,

a1) a first set consisting of codevectors of dimension **n+i**, where [[with]] i is ~~being~~ a non negative integer, formed by inserting into codevectors of the initial dictionary elements taken from a finite set of real numbers according to a finite collection of predetermined insertion rules is constructed,

a2) there is provided a second set consisting of codevectors of dimension **n+i** that may not be obtained by insertion into the codevectors of the initial dictionary of the elements of said finite set with said collection of insertion rules,

a3) an intermediate dictionary, of dimension **n+i** comprising a union of said first set and of said second set is constructed,

and steps a1) to a3) are repeated, at most **N-n-1** times, with said intermediate dictionary in the guise of initial dictionary, up to said given dimension **N.**

Claim 6 (currently amended): A method for operating a coding-decoding device having a processor, comprising:

forming a dictionary comprising codevectors of variable dimension and ~~intended to be used in a device for compression coding and/or decoding of digital signals, by vector quantization at variable rate defining a variable resolution~~, in which, for a given dimension:

a) forming a first set consisting of codevectors ~~formed~~ by performing an editing operation comprising at least one of inserting into and deleting from codevectors of dictionaries of dimension elements comprising at least one of lower and higher dimension elements taken from a finite set of real numbers according to a finite collection of predetermined editing operation rules,

b) constructing a first, intermediate, dictionary comprising at least said first set is ~~constructed~~, for said given dimension,

c) adapting ~~and, to adapt~~ said dictionary to a use with at least one given resolution, a second, definitive, dictionary is constructed, on the basis of the intermediate dictionary, by performing at least one of embedding and simplification of dictionaries of at least one of increasing and decreasing resolutions, the dictionaries of increasing resolutions being inter-embedded from the dictionary of smallest resolution up to the dictionary of greatest resolution;

in which, for a given dimension **N**:

a'0) obtaining an initial dictionary of initial dimension **n**, higher than said given dimension **N**, ~~is obtained~~,

a'1) constructing a first set, of dimension **n-i**, where [[with]] i is ~~being~~ a non negative integer, ~~is constructed~~ by selecting and extracting ~~selection and extraction~~ of possible codevectors of dimension **n-i** from the dictionary of dimension **n**, according to a finite collection of predetermined deletion rules,

a'2) providing ~~there is provided~~ a second set consisting of codevectors of dimension **n-i**, that may not be obtained by deletion, from the codevectors of the initial dictionary, of the elements of said finite set with said collection of deletion rules,

a'3) constructing an intermediate dictionary, of dimension **n-i** comprising a union of said first set and of said second set ~~is constructed~~, ~~and~~

repeating steps a'1) to a'3) ~~are repeated~~, at most **n-N-1** times, with said intermediate dictionary in the guise of initial dictionary, down to said given dimension **N**; and

performing at least one of coding and decoding digital signals using the processor, by vector quantization at variable rate defining a variable resolution, using the formed dictionary.

Claim 7 (previously presented): The method as claimed in claim 5, in which **N** successive dictionaries of respective dimensions **1** to **N** are obtained on the basis of an initial dictionary of dimension **p**, through the repeated implementation of steps a1) to a3) for the dimensions **p+1** to **N**, and through the repeated implementation of steps a'1) to a'3) for the dimensions **p-1** to **1.**

Claim 8 (previously presented): The method as claimed in claim 4, in which said collection of editing operation rules is formulated on the basis of elementary rules consisting in performing the editing operation on a single element of the finite set of reals in the guise of component at a given position of a vector.

Claim 9 (previously presented): The method as claimed in claim 8, in which each elementary rule is defined by a pair of two positive integers representative:

- of a rank of the element in said finite set,
- and of a position of the editing operation .

Claim 10 (previously presented): The method as claimed in claim 4, in which said finite set and said collection of editing operation rules are defined a priori, before constructing the dictionary by analysis of a source to be quantized.

Claim 11 (previously presented): The method as claimed in claim 10, in which said source is modeled by a learning sequence and the definition of said finite set and of said collection of editing operation rules is effected by statistical analysis of said source.

Claim 12 (previously presented): The method as claimed in claim 10, in which said finite set is chosen by estimation of a monodimensional probability density of said source.

Claim 13 (previously presented): The method as claimed in claim 4, in which said finite set and said collection of editing operation rules are defined a posteriori after construction of dictionaries by performing at least one of embedding and simplification of dictionaries of successive resolutions, followed by a statistical analysis of these dictionaries thus constructed.

Claim 14 (previously presented): The method as claimed in claim 10, in which:

- a first set and a first collection of editing operation rules are chosen a priori by analysis of a learning sequence, so as to form one or more intermediate dictionaries,

- at least one part of said first set and/or of said first collection of editing operation rules is updated by a posteriori analysis of said one or more intermediate dictionaries,
- and, as appropriate, at least one part of the set of codevectors forming said one or more intermediate dictionaries is also updated.

Claim 15 (currently amended): A method for operating a coding-decoding device having a processor, comprising:

forming a dictionary comprising codevectors of variable dimension ~~and intended to be used in a device for compression coding and/or decoding of digital signals, by vector quantization at variable rate defining a variable resolution,~~ in which, for a given dimension, the method comprising:

a) forming a first set consisting of codevectors ~~formed~~ by performing an editing operation selected from the group consisting ~~comprising at least one~~ of inserting into and deleting from [[on]] codevectors of dictionaries of dimension elements comprising at least one of lower and higher dimension elements taken from a finite set of real numbers according to a finite collection of predetermined editing operation rules,

b) constructing a first, intermediate, dictionary comprising at least said first set ~~is constructed~~, for said given dimension, and

c) adapting ~~and, to adapt~~ said dictionary to a use with at least one given resolution, a second, definitive, dictionary is constructed, on the basis of the intermediate dictionary, by performing at least one of embedding and simplification of dictionaries of at least one of increasing and decreasing resolutions, the dictionaries of increasing resolutions being inter-embedded from the dictionary of smallest resolution up to the dictionary of greatest resolution; wherein

step c) further comprises ~~the following operations~~:

c0) obtaining an initial dictionary of initial resolution $\mathbf{r_n}$, lower than said given resolution $\mathbf{r_N}$, ~~is obtained,~~

c1) constructing on the basis of the initial dictionary, an intermediate dictionary of resolution $\mathbf{r_{n+1}}$ higher than the initial resolution $\mathbf{r_n}$ ~~is constructed~~,

c2) repeating step ~~operation~~ c1) ~~is repeated~~ until the given resolution $\mathbf{r_N}$ is attained; and

performing at least one of coding and decoding digital signals using the processor, by vector quantization at variable rate defining a variable resolution, using the formed dictionary.

Claim 16 (original): The method as claimed in claim 15, in which, for each iteration of operation c1), there is provided a construction of classes and of centroids, in which the centroids belonging at least to the dictionaries of resolution higher than a current resolution $\mathbf{r_i}$ are recalculated and updated.

Claim 17 (original): The method as claimed in claim 16, in which the centroids which belong to the dictionaries of resolution lower than a current resolution $\mathbf{r_i}$ are updated only if the total distortions of all the dictionaries of lower resolution are decreasing from one update to the next.

Claim 18 (currently amended): The method as claimed in claim 4, in which step c) comprises ~~the following operations~~:

c'0) obtaining an initial dictionary of initial resolution $\mathbf{r_n}$, higher than said given resolution $\mathbf{r_N}$, ~~is obtained~~,

c'1) constructing, on the basis of the initial dictionary, an intermediate dictionary of resolution $\mathbf{r_{n-1}}$ lower than the initial resolution $\mathbf{r_n}$, ~~is constructed~~ by partitioning of the initial dictionary into several subsets ordered according to a predetermined criterion, and

c'2) repeating step ~~operation~~ c'1) ~~is repeated~~ until the given resolution $\mathbf{r_N}$ is attained.

Claim 19 (original): The method as claimed in claim 18, in which said predetermined criterion is chosen from among the cardinal of the subsets, an invoking of the subsets in a learning sequence, a contribution of the subsets to a total distortion or preferably to a decrease of this distortion.

Claim 20 (previously presented): The method as claimed in claim 18, in which said partition uses part at least of said editing operation rules.

Claim 21 (previously presented): The method as claimed in claim 15, in which **N** successive dictionaries of respective resolutions $\mathbf{r_1}$ to $\mathbf{r_N}$ are obtained on the basis of an initial dictionary of intermediate resolution $\mathbf{r_n}$, by the repeated implementation of step c1) for the increasing resolutions $\mathbf{r_{n+1}}$ to $\mathbf{r_N}$, and through the repeated implementation of step c'1) for the decreasing resolutions $\mathbf{r_{n-1}}$ to $\mathbf{r_1}$.

Claim 22 (currently amended): The method as claimed in claim 4, in which, to adapt said dictionary to a use with a given dimension **N** of codevectors, steps a), b), and c), are substantially inverted so that the method comprises:

- in step c), constructing a first, intermediate, dictionary still of dimension **N'** but of at least one of higher and lower resolution $\mathbf{r_N}$ ~~is constructed~~ on the basis of an initial dictionary of resolution $\mathbf{r_n}$ and of dimension **N'** by performing at least one of embedding and simplification of dictionaries of at least one of increasing and decreasing resolutions, so as to substantially attain the resolution $\mathbf{r_N}$ of said first dictionary,
- in step a), forming, to attain the given dimension **N**, a first set consisting of codevectors ~~formed~~ by performing an editing operation that is at least one of inserting into and deleting from codevectors of the first dictionary of dimension **N'** at least one of lower and higher than said given dimension **N** elements taken from a finite set of real numbers according to a finite collection of predetermined editing operation rules is constructed,
- and, in step b), subsequent to a possible step of definitive adaptation to the resolution $\mathbf{r_N}$, constructing a second, definitive, dictionary comprising at least said first set ~~is constructed~~ for said given dimension **N**.

Claim 23 (previously presented): The method as claimed in claim 4, further comprising storing in a memory said collection of editing operation rules, each identified by an index (l_r), and, for a given dimension:

- said second set consisting of codevectors that may not be obtained by

application of the editing operation to codevectors of at least one of lower and higher dimension than the given dimension according to said collection of editing operation rules,

- as well as at least one correspondence table making it possible to reconstitute any codevector of the dictionary of given dimension, using the indices of the editing operation rules and indices identifying elements of said second set,

thereby making it possible to avoid the complete storage of the dictionary for said given dimension, by simply storing the elements of said second set and links in the correspondence table for access to these elements and to the associated editing operation rules.

Claim 24 (previously presented): The method as claimed in claim 23, in which the correspondence tables are formulated previously, for each index (m^j) of a codevector (x^j) of the dictionary ($\mathbf{D^j_{Nj}}$) of given dimension (j) that may be reconstructed on the basis of elements of current indices (m') in the second set of current dimension (j'), through a tabulation of three integer scalar values representing:

- a current dimension (j') of said second set,
- a current index (m') of an element of the second set, and
- an editing operation rule index (l_r),

this editing operation rule at least contributing to reconstitute said codevector (x_j) of the dictionary (D^j_{Nj}) of given dimension (j), by applying the insertion/deletion to the element of said current index (m') and of said current dimension (j').

Claim 25 (currently amended): A method for operating a compression coding-decoding device having a processor ~~coding or decoding of digital signals, by vector quantization at variable rate defining a variable resolution~~, comprising:

searching for a codevector (x^j) which is the nearest neighbour of an input vector $y=(y_0, \ldots, y_k, \ldots, y_{j-1})$ in a dictionary (D^i_j) of given dimension (j),

said codevectors being reconstituted by using at least one correspondence table making it possible to reconstitute any codevector of the dictionary of said given dimension, using indices of a collection of editing operation rules selected from the group consisting of insertion rules and deletion rules ~~that are at least one of insertion and deletion rules~~ and indices identifying elements of a set of codevectors that may not

be obtained by application of the editing operation to codevectors of at least one of lower and [[or]] higher dimension than the given dimension according to said collection of editing operation rules,

~~and further comprising the following steps:~~

CO1) reconstituting, for a current index (m^j) of said codevector (x^j) sought, ~~reconstitution~~ at least partial of a codevector of index (m') corresponding to said current index (m^j), at least through the prior reading of the indices (j', m', l_r) appearing in the correspondence tables making it possible to formulate said dictionary,

CO2) calculating at least on coding, ~~calculation~~ of a distance between the input vector and the codevector reconstituted in step CO1),

CO3) repeating steps CO1) and CO2), at least on coding, ~~repetition of steps CO1) and CO2),~~ for all the current indices in said dictionary,

CO4) identifying, at least on coding, ~~identification~~ of the index (m_{min}) of the codevector at least partially reconstituted whose distance (d_{min}), calculated in the course of one of the iterations of step CO2), with the input vector is the smallest, and

CO5) determining at least on decoding, ~~determination~~ of the nearest neighbour of the input vector (y) in the guise of codevector (x^j) whose index (m_{min}) has been identified in step CO4);

producing, using the processor, at least on coding, a coded digital signal using the identified index (m_{min}); and

producing, using the processor, at least on decoding, a decoded digital signal using the determined nearest neighbour of the input vector (y).

Claim 26 (previously presented): The method as claimed in claim 25, in which step CO1), at least on decoding, comprises:

CO11) the reading, in the correspondence tables, of indices representative of links to said second set and to the editing operation rules and including:

- the index of a current dimension of a subset of said second set,

- the current index of an element of said subset,
- and the index of the appropriate editing operation rule for the construction of the codevector of the dictionary of given dimension, on the basis of said element,

CO12) the reading, in the subset identified by its current dimension, of said element identified by its current index,

CO13) the complete reconstitution of the codevector to said given dimension by applying to said element read in step CO12) the appropriate editing operation rule identified by its index read in step CO11).

Claim 27 (currently amended): The method as claimed in claim 25, in which, on coding,

[[*]] step CO1) comprises:

CO11) the reading, in the correspondence tables, of indices representative of links to said second set and to the editing operation rules and including:

- the index of a current dimension of a subset of said second set,
- the current index of an element of said subset,
- and the index of the appropriate editing operation rule for the construction of the codevector of the dictionary of given dimension,

CO12) the reading, in the subset identified by its current dimension, of said element identified by its current index,

[[*]] in step CO2), said distance is calculated as a function of a distortion criterion estimated as a function of:

- the index of the editing operation rule,
- and of the element of the subset identified by its current index,

thereby making it possible to only partially construct the codevector with said given dimension in step CO1), by reserving the complete reconstruction simply for decoding.

Claim 28 (previously presented): The method as claimed in claim 25, in which there is provided furthermore a supplementary structuring property according to a union of permutation codes and utilizing an index of said union of permutation codes, and in which:

CP1) on the basis of an input signal, an input vector $y=(y_0, \ldots, y_k, \ldots, y_{j-1})$ defined by its absolute vector $|y|=(|y_0|,\ldots,|y_k|,\ldots,|y_{j-1}|)$ and by a sign vector $\varepsilon=(\varepsilon_0,\ldots,\varepsilon_k,\ldots,\varepsilon_{j-1})$ with $\varepsilon_k=\pm 1$ is formed,

CP2) the components of the vector |y| are ranked by decreasing values, by permutation, to obtain a leader vector $|\tilde{y}|$,

CP3) a nearest neighbour $x^{j'}$ of the leader vector $|\tilde{y}|$ is determined from among the leaders of the dictionary D^j_i of dimension j,

CP4) an index of the rank of said nearest neighbour $x^{j'}$ in the dictionary D^j_i is determined,

CP5) and an effective value of at least one of coding and decoding is applied to the input vector, which is dependent on said index determined in step CP4), on said permutation determined in step CP2) and on said sign vector determined in step CP1).

Claim 29 (previously presented): The method as claimed in claim 25, in which at least said correspondence tables are stored in a memory of at least one of coding and decoding devices.

Claim 30 (previously presented): A computer readable memory storing a computer program product intended to be stored in a memory of a processing unit, in particular of a computer or of a mobile terminal, or on a removable memory medium and intended to cooperate with a reader of the processing unit,
wherein it comprises instructions for implementing the method according to claim 4.

Claim 31 (previously presented): A computer readable memory storing a computer program product intended to be stored in a memory of a processing unit, in particular of a computer or of a mobile terminal integrating at least one of coding and decoding device, or on a removable memory medium and intended to cooperate with a reader of the processing unit, wherein it comprises instructions for implementing the method according to claim 25.

Claim 32 (currently amended): The method as claimed in claim 13, <u>further comprising</u> ~~in which~~:

- <u>choosing, a priori,</u> a first set and a first collection of editing operation rules ~~are chosen a priori~~ by analysis of a learning sequence, so as to form one or more intermediate

dictionaries,

- updating at least one part of said first set and/or of said first collection of editing operation rules ~~is updated~~ by a posteriori analysis of said one or more intermediate dictionaries,

- and, as appropriate, also updating at least one part of the set of codevectors forming said one or more intermediate dictionaries ~~is also updated~~.